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HOW DO REAL EXCHANGE RATE MOVEMENTS AFFECT THE ECONOMIC GROWTH IN IRAN?

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Abstract

This paper, through an asymmetric and non-linear framework, NARDL Model, investigates how real exchange rate movements affect the economic growth of Iran. In other words, whether the movements in the real exchange rate is an indicator of economic growth changes. Working on the monthly data of Gross Domestic Production (GDP) and Real Exchange Rate indexes from November 2009 to November 2019, this study shows asymmetric and negative relationships between exchange rate and economic growth both in the long run and short run. Although, in the long run, the magnitude of effects both positive and negative components of exchange rate on economic growth were significantly more than those of short run, the stability of the results have indicated that the roots of existing nonlinear and asymmetric relationships among these variables are so strong that change in time horizon, from the short run to long run, has also not been able to change them.

Keywords: Economic Growth, Exchange Rate, NARDL, Nonlinear and Asymmetric Relationships.

JEL Classification: F43, O24, F31, C22, C52.

1. Introduction

Given the importance and function of economic growth in the process of economic development, identifying the determinants of this macro-level variable is one of the primary and essential steps towards economic planning to achieve sustainable economic growth. In the meanwhile, regardless of the countries development levels, exchange rate movements, the status of the foreign exchange market, and the choice of the exchange rate regime are among the main determinants of economic growth (Ribeiro et al., 2019; Hadj Fraj et al., 2018; Motahari et al., 2018). However, the controversial point is that there is a significant difference between the economists' and policy-makers' perspectives towards the effects of foreign exchange policies on economic growth, especially for emerging

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and developing economies. While politicians are often convinced that economic growth would significantly be affected by the lower exchange rate, economists are generally of the opinion that the exchange rate and the relative price of two different currencies may not be the most influential drivers of economic growth over the long-term (Hadj Fraj et al., 2018; Vita and Kyaw, 2011). To be more precise, most of the economists give credence to the idea that the exchange rate as an endogenous variable depends on several determinants which roots of their changes specify the direction of exchange rate changes. In this regard, although the effects of such a crucial variable on economic growth have been immensely considered and documented in the empirical literature, there has emerged no solid consensus on this issue yet (Ribeiro et al., 2019; Alagidede and Ibrahim, 2017; Adeniran et al., 2014; Petreski, 2010).

There is a serious and challenging question about the effect of exchange rate movements on different key economic variables like economic growth which is whether exchange rate movements has overt and significant effects on economic growth or their relationship is not solid and depends on lots of other conditions. To address this question it can be considered that the exchange rate appreciation, generally, have two distinct effects on economic growth include: (i) its indirect effects through moving down the aggregate supply curve of the economy that would occur due to the increasing the average production costs as a result of enhancing the prices of imported production inputs, and (ii) its direct impacts through moving up the aggregate demand curve, which means if the exchange rate appreciation (or currency depreciation) policy implements (assuming stability of other conditions), the Foreign Direct Investment, FDI, net exports, and other components of aggregate demand would enhance, which is equivalent to the growth of Gross Domestic Products, GDP (Chandan Babu et al, 2019; Cushman and De Vita, 2017; Habib et al., 2017). On this basis, if the Marshall-Lerner condition works, and the nominal prices were not sticky, it is anticipated that the decline in national currencies value would culminate in a net boost in exports; in this way, the significant enhancement in total productions; consequently, would be led to more economic growth. These conditions would be in place, as a sufficient condition, if the negative effects of the decline in national currencies value do not outweigh its positive effects (Ali and Anwar, 2011). For instance, if there are problems with the supply-side sector, the infrastructures of the economy, the capacities in the export sector, or so forth, an increase in the exchange rate can be led to a decline in economic growth (Mao et al., 2019). All in all, the empirical evidence in most countries, like Iran, does not show a clear and distinct conclusion on this issue (Motahari et al., 2018; Petreski, 2010). Therefore, the existence of such conditions, which indicates the uncertainty in the economic condition of this country, enhances the importance and necessity of investigating the relationship between exchange rate movements and economic growth.

In addition, since most of the published studies, especially in the sphere of Iran's economy, have neglected the possibility of an asymmetrical relationship between the real exchange rate and economic growth, using an asymmetric and non-linear relationship between these variables, through NARDL model, can be considered as a plausible response to address this concern. The reasons that mainly

support using asymmetric and non-linear relationship between these variables in Iran are the existence of a pegged exchange rate regime and its inefficiency to be considered as a sign of the economy's real potential, imposing heavy sanctions on the economy of Iran, the recent terrible exchange rate shocks (drastic foreign currency appreciation due to the United States withdrawal from the Joint Comprehensive Plan of Action, JCPOA, agreement), and the complexity of supply and demand channels in response to the foreign currency appreciation. To be more precise, this complexity of supply and demand channels that can disturb the balance of supply and demand may have aroused (i) in the goods market (by unbalanced impacts on exports and imports which would result in enhancement of domestic prices, total domestic investment, aggregate supply and demand), (ii) in the money market (through increasing the demand of agents for domestic currency and augmenting the interest rate would moderate both the expansion of inflation and aggregate demand, and also the reduction of investment, output, and aggregate supply), and (iii) on the aggregate supply-side (by reducing domestic output as a result of increasing the cost of most imported intermediate goods, enhancing the cost of productions, and rising inflation) (Mao et al., 2019; Chandan Babu et al., 2019, Ali and Anwar, 2011). Under such circumstances, using models that consider nonlinear and asymmetric properties between the mentioned variables may be able to provide more reliable results which are more consistent with empirical evidence.

Therefore, since the main concern of this study is to precisely analyze and model the relationship between real exchange rate changes and economic growth, this research empirically analyzes this relationship by employing monthly data from November 2009 to November 2019, and through utilizing the NARDL model that is capable of modelling the relationship in different time horizon. On this basis, in what follows, section 2 provides further details on the Theoretical Framework, section 3 includes Methodology and Data. In section 4, the empirical results are reported. Finally, section 5 concludes the work.

2. Theoretical Framework

2.1. Stylized Facts

To understand Iran’s status quo particularly in the realm of economic, in addition to stating the economic conditions of Iran’s economy, a brief review of pertinent statistics related to the economic growth and the foreign exchange market will also be examined to figure out the major stylized facts in this economy. It should be noted that the manufacturing statistics are gathered from the central bank of Iran’s databank.

A. The state of Economic Conditions in Iran

More than a hundred years have passed from the first major oil field discovery in Iran, and during this period, not only has oil production continued uninterruptedly, but the dependence of the Iranian economy on these resources has enhanced significantly. As the second-largest country based on natural gas

reservoirs, and the fourth country with the world's largest oil resources (the reports of the U.S. Energy Information Administration, 2018), Iran has so far failed to gradually reduce the share of revenues from exporting these resources in its GDP and economic growth. On the ground that these revenues account for a significant portion of the government budget funding, the foreign exchange market equilibrium, the imported goods and services costs, and so forth. In line with this, there are some factors that have played prominent roles in Iran's failure to decrease the share of oil and other resources' revenues from its GDP and economic growth include: the existence of different sangtions against Iran, large public sector, inefficient financial markets, tight control on exchange rate and interest rate (which are not market-determined), excessive dependency on the imported goods and services while its share in international trade comes remarkably form exporting oil, gas, and petrochemical products revenues of which are usually fragile (especially due to the repercussions of the international sanctions), and more importantly, international disagreement with a number of Western countries on some political and strategic issues (Reed et al., 2019; Nademi and Baharvand, 2019; Parsa et al., 2019; Komijani et al., 2014). Consequently, such conditions have caused that oil shocks and the resulted revenue shocks to be the major source of macroeconomic fluctuations by which, in return, most of the economic policies, as well as economic activities in macro and micro level, has been affected (Farzanegan and Krieger, 2019).

Aside from the importance of the oil market for the oil-exporting country, it should be noted that the foreign exchange market plays a crucial role in transmitting the exogenous and international shocks, i.e. oil shocks, to the domestic economy, and most of the times, the movements in this market is the first domestic indicator that response to the international shocks. As a result, given the high volume of imports and exports of the Iranian economy, and the exchange rate's fragility due to its excess reliance on oil-exporting revenues on the one hand and the government's excessive borrowing from the central bank and its interventions in determining exchange rate, on the other hand, the ramifications of such conditions in the foreign exchange market not only have led to a significant increase in the effects of international shocks on the economy, but the results of planning for reaching a sustainable economic growth has not been adequately successful as planned (Parsa et al., 2019). In this regard, as the results of experimental studies about the outcome of different "Five-Year Economic, Cultural, and Social Development Plans" have shown, a significant reason for the failure of Iran's economic development programs ascribed to the lack of attention to stabilizing the foreign exchange market (Nademi and Baharvand, 2019). These conditions emphasize on the overwhelming dependence of the Iranian economy on its fragile and uncontrolled oil revenues that its shocks, usually through the exchange rate channel, pass-through into the general level of prices, inflation, as well as economic growth (Farzanegan and Krieger, 2019). Therefore, a brief review of the economic conditions in Iran illustrates that the resultant effect of major exogenous variables which impose systematic risk on the production and, finally, economic growth of the country can be tracked down through analyzing the effects of real exchange rate movements on economic growth.

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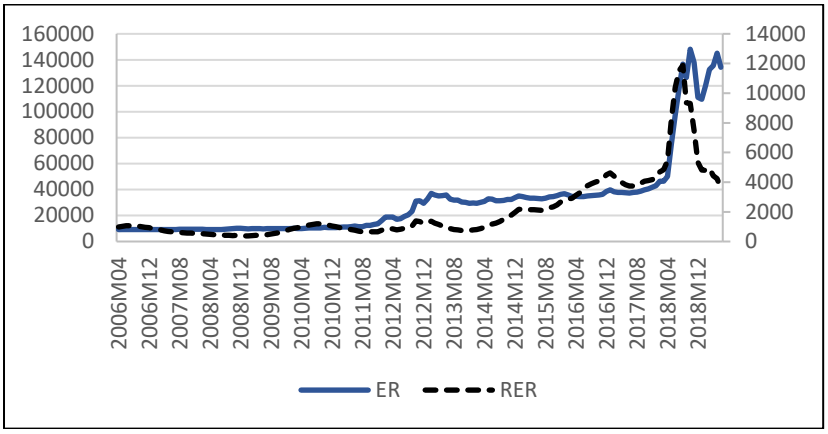
B. Trends in the Nominal and Real Foreign Exchange Rate

In this section, the comparison between the nominal and real exchange rate during the research period will be examined. For this purpose, the time-series graph of both types of the exchange rate is presented below.

Graph 1: Evolution of Nominal and Real Exchange Rate (USD to IRR)



* ER is the nominal exchange rate and RER presents the real exchange rate

** Calculation of the RER is based on $RER = \frac{ER \times P}{P^*}$ formula in which P expresses Domestic Price Index, and P* shows the foreign price index (in the US).

Source: The databanks of the central bank and Statistical Centre of Iran of Iran and also World Development Indicators (WDI)

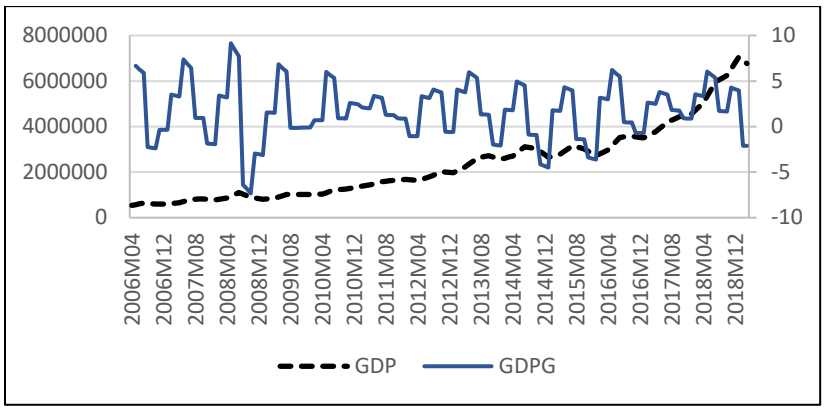
For the overall sample, four different periods can, approximately, be considered for the movements in the nominal exchange rate in Iran: (i) from the beginning of 2006 by mid-2011 during which the foreign exchange market was relatively stable; (ii) The period of sharp exchange rate fluctuations from the mid-2011 by mid-2013; (iii) from mid-2013 to the beginning of 2018 during which the gradual and smoothing growth of the exchange rate occurred from 32000 up to 42000 Rial; (iv) Period of an unprecedented jump along with massive fluctuations from the beginning of 2018 to the beginning of 2019. However, by comparing the nominal and real exchange rates graphs, it can be found that in most of the times, the real exchange rates are less than the nominal one which means the existence of significant inflation rate plays its role in decreasing the real exchange rate. Moreover, in some periods like the middle months of 2006 and 2010 and also from the mid-2016 to mid-2018, the inflation rate has been fallen sharply to single-digit figures; consequently, the real exchange rate has risen relative to the nominal exchange rate, and thus the graph of the real exchange rate is located above that of the nominal exchange rate. In addition, during some periods like the beginning months of 2013 to the middle months of 2014 and also after mid-2018 by the end of the sample period, the gap between the nominal and real exchange rate has widened due to the dramatic inflation increasing (i.e. over 25 percent). Therefore,

through comparing the movements of nominal and real exchange rates over different years, it can be concluded that in order to provide a more realistic and efficient analysis, it is necessary to evaluate the effects of the real exchange rate on economic growth.

C. Trends in GDP and Economic Growth

After examining the trends of different types of exchange rate in the previous section, this section will contain the interaction between the GDP and real economic growth. In this regard, based on the GDP and Economic Growth graphs, the major changes in these indexes will be clarified as follows.

Graph 2: Evolution of the GDP and Economic Growth (Iran)



Source: The databank of the central bank of Iran

The main points that can be maintained through comparing the graphs of GDP and economic growth include: (i) although in some periods the GDP has experienced a decline compared to the previous year, it has relatively raised during the research period; (ii) it seems throughout the periods that the real exchange rate has had some significant fluctuations, the GDP and its growth experienced remarkable changes; (iii) Iran's economic growth has not been stable and constant, and we have seen negative economic growth on some occasions which imply the Iranian economy is vulnerable and somehow unstable; (iv) the range of changes in the economic growth has been low in some years (like from 2010 to 2012) and high in others (especially from 2006 to 2009).

Based on the brief review of changes in economic growth and also exchange rate, it can be found that there are some related significant changes in different periods of these variables; consequently, there is a need to conduct academic research to accurately address whether the real exchange rate is an indicator of economic growth. To this end, in what follows, the theoretical concepts related to these variables relationship will be presented.

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Real Exchange Rate and Economic Growth: Theory and Empirical Evidence

In this section, the theoretical and empirical evidence related to the relationship between exchange rate movements and economic growth will be delineated. Given the fact that, throughout the years, there have been continuous efforts to improve the quality of life and increase the welfare of the society through increasing the aggregate production, reducing the unemployment rate, enhancing the total investment, improving the income per capita, and stabilizing economic growth. Hence, it causes a shift in the interests of a great number of researchers into the field of economic growth. For this purpose, due to the undeniable role of exchange rate and the importance of foreign exchange market movements in pushing the large-scale investments of the economy, determining the direction of the aggregate productions, and propelling the exports and also the balance of trade, some significant part of the studies in this field is focused on the relationship between exchange rate and economic growth (Mao et al., 2019; Harms and Kretschmann, 2009).

On this basis, to analyze the linkages between the real Exchange rate and economic growth, it necessary to know that although the Balassa-Samuelson effect, traditionally, refers to the existence of a positive relationship between real exchange rate appreciation and economic growth in long-term (since countries with a lower level of income per capita which grow faster tend to enhance their exchange rates, appreciation, over time), there is not a solid relationship between these variables in different types of countries. To be more precise, based on some researches, the movements of the real exchange rate around its equilibrium level can significantly cause a positive or negative effect on economic growth. The other studies that have concentrated on the impacts of exchange rate volatilities on the economic growth has suggested that the impact of highly volatile exchange rate on economic growth has been negative (Rodrik, 2008; Adeniran et al, 2014), however, the impacts of moderately fluctuated exchange rate on economic growth have reported positive (Petreski, 2010; Chandan Babu et al., 2019).

Furthermore, all the mentioned concepts about the relationship between these variables in the real world can be interpreted differently. In line with this, some other researchers like Rodrik, 2008, based on the database of 188 countries from 1950 to 2004, has proven this nexus varies somehow from developing and emerging countries to the developed ones. More precisely, in developing countries, an undervalued real exchange rate would lead to stronger economic growth. In more details, in the economy of emerging and developing countries, the value of currencies, usually, overestimates (overvalued) or underestimates (undervalued) from what it ought to be. As a result, while the undervalued exchange rate (depreciation) enhances economic growth (Rodrik, 2008), the overvaluation of exchange rate (appreciation) has negative effects on the growth (Rodrik, 2008; Alagidede and Ibrahim, 2017).

In addition, another interesting analysis about the nexus between economic growth and exchange rate comes from the research of Glüzmann et al (2012) that has investigated the exchange rate undervaluation's impacts on the different components of Gross Domestic Products, GDP. The results of their research have demonstrated that although undervalued currencies cannot affect the export sectors appropriately, it can have significant impacts on domestic saving, total investments, employment, Total production, and growth.

Moreover, an increasing number of researchers in this field of study mainly focuses on the effect of the exchange rate regime on economic growth. These studies sought to answer the question can different exchange rate regimes have distinct significant effects on the growth? The results of previous researches pointed out that while the flouting (flexible) exchange rate regime can positively affect the growth (Alagidede and Ibrahim, 2017), there is a negative link between exchange rate and economic growth under the fixed (pigged) exchange rate policies (Benhima, 2012). Besides, in emerging economies, through Intermediate exchange rate policies which has a lack of flexibility, the correlation between exchange rate and economic growth would be positive (Alagidede and Ibrahim, 2017). Regarding this issue, the findings of the Harms and Kretschmann (2009) research seems to be quite interesting. In this study, the researchers have found that different types of regimes, in practice, do not have significantly distinct effects on the growth of advanced economies. It is because in most of industrialized countries (which are usually under the flexible exchange rate regime), not only are the economic growth stable and in a definite range, but also the currency in such countries have not been only pegged to a foreign exchange rate, e.g. USD. However, in developing countries, on the one hand, due to relatively less stability in the foreign exchange market and economic growth, and also the relative inefficiency of existing rate regime, the real exchange rate and economic growth normally have had a positive relationship. On the other hand, the existence of a noticeable peg to the US Dollar (dollarization of currency) in the currency of some developing countries, the direction of the relationship between the exchange rate and economic growth may change significantly. To put it differently, the more the level of the dollarization in an economy, the more likely the existence of a negative relationship between exchange rate and economic growth (Benhima, 2012). To complete the findings of this area, Vita and Kyaw in 2011 pointed out that the long-run link between exchange rate and economic growth has nothing to do with the type of exchange rate regime.

Finally, given the indigeneity of exchange rate and its dependence on its determinants, it is not a comprehensive investigation that we ascribe the changes in economic growth only to real exchange rate depreciation. To address this claim, it should be noted that some specific shocks in a country, e.g. productivity shocks, may affect the real exchange rate so that the causality between exchange rate and growth completely reverse (Habib et al, 2017). Therefore, if the inextricable link between exchange rate and its determinants, like monetary policies, inflation rate, target nominal interest rates, money supply, etc., are taken into account during the nexus between real exchange rate and economic growth, the depth of investigation and the reliability of the results will enhance significantly (Reed et al., 2019).

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All in all, the evidence on the effects of real exchange rate on economic growth is unclear especially if there were some sequential inconsistent events, the sign of dollarization of currency in an economy, and some terrible exchange rate shocks during the research period; consequently, as suggested by Benhima, 2012; Ribeiro Marques, 2019, such conditions can be considered as some degree of asymmetric or non-linear relationship between the variables. Using the NARDL model along with the ability to analyze the asymmetric or non-linear relationship between the variables, can provide the possibility of estimating the short-run dynamics as well as long-run equilibrium between them in the economy of Iran.

3. Methodology and Data

To investigate the relationship between real exchange rate (LRER) and economic growth ($GDPG_t$) in Iran, a nonlinear and asymmetric ARDL method based on logarithmic annual time series data will be used. The most important reasons for applying the nonlinear and asymmetric model in analyzing the relationship between these two variables are: (i) The intrinsic and technical properties of these models, such as the ability to analyze the relationships of variables in different time horizons (include short run and long run) or in other words provide dynamic analyzes through analyzing the Error Correction Term (ECT); (ii) The remarkable features of the new version of ARDL models, i.e. NARDL, are the possibility of analyzing nonlinear and asymmetric relationships between different variables, make a distinction between the asymmetric effects of positive and negative changes in exogenous variables on endogenous one separately and in the form of divided coefficients; (iii) Conceptual features of this model and its significant consistency with research objectives and variables (Motahari et al., 2018). More precisely, on the one hand, the target variable of this study is economic growth, which is usually influenced by different indicators, gradually and with some lags, and the exogenous variable of research is exchange rate which the impacts of its changes or volatilities would take time to affect the aggregate production and economic growth (Benhima, 2012; Alagidede and Ibrahim, 2017). On the other hand, the primary feature of ARDL-type models is considering the efficient number of each variable's lags that, in turn, by limiting the degree of freedom lost can significantly improve the performance of estimated model (Hussain et al., 2019). Therefore, using this type of models seems logical and theoretically defensible.

To clarify the NARDL model it should be noted that if there are some non-stationary variables in the inputs of the model, the pre-requirements of using NARDL model should be examining the co-integration through the long-run relationship is essential. After confirming the existence of long-run relationship among the variables, two stages based on which the NARDL model estimates, i.e. separately estimating the long-run and short-run relationships, will be presented (Shin et al. 2014). In line with this, the long-run relationship between the research variables is evaluated by the below equation:

$$Long-Run \rightarrow \ LGDP_t = C_0 + C_1\, LRER_t^+ + C_2\, LRER_t^- + u_t \qquad (1)$$

In which, $LRER_t^+$ and $LRER_t^-$, respectively, present cumulative positive and negative changes of $LRER_t$ and are decomposed as follows:

$$LRER_t^+ = \sum_{t=1}^{n} \Delta LRER_t^+ = \sum_{t=1}^{n} \max(\Delta LRER_t, 0)$$
$$and \qquad (2)$$
$$LRER_t^- = \sum_{t=1}^{n} \Delta LRER_t^- = \sum_{t=1}^{n} \min(\Delta LRER_t, 0)$$

After estimating the long-run equation, the presence of an asymmetric long-run relationship among the level of variables should be scrutinized by the bound testing approach. For this purpose, there are two different criteria: F-bound, introduced by Pesaran et al (2001), and t-statistic, proposed by Banerjee et al (1998). As the second step of NARDL, after establishing the long-run bond, the short-term and dynamic relationship among these variables is estimated, as follows:

$$Short-Run \rightarrow \underbrace{\Delta LGDP_t}_{GDPG} = C_4 + \sum_{j=1}^{p} \alpha_j \ \ \Delta LGDP_{t-j} + \sum_{i=0}^{q_1} \beta_i \ \ \Delta LRER_{t-i}^+ + \qquad (3)$$
$$\sum_{k=0}^{q_2} \beta_k \ \ \Delta LRER_{t-k}^- + \rho\, LGDP_{t-1} + \theta_1\, LRER_{t-1}^+ + \theta_2\, LRER_{t-1}^- + \varepsilon_t$$

To grant the accuracy and reliability of asymmetric long-run, short-run and dynamic relationship among the survey variables, although distinctive coefficients of independent variables' positive and negative components are evaluated, it should be examined through the Wald test to be statistically proven. Hence, via the Wald test, the equality of $LRER_t^+$ and $LRER_t^-$ coefficients in both long, $C_1 = C_2$, and short, $\sum_{i=0}^{q_1} \beta_i = \sum_{k=0}^{q_2} \beta_k$, –run will be assessed. Moreover, to survey the existence of asymmetric either dynamic relationship among variables in the NARDL model or short-run pass-through to long-run one, the below fractions should be calculated and then analyzed by the Wald test, as follows:

$$\underbrace{Short-Run \rightarrow Long-Run}_{h \rightarrow \infty}: \begin{cases} m_h^+ = \sum_{r=0}^{h} \dfrac{\partial LGDP_{t+r}}{\partial LRER_{t+r}^+} \\ m_h^- = \sum_{r=0}^{h} \dfrac{\partial LGDP_{t+r}}{\partial LRER_{t+r}^-} \end{cases} \qquad (4)$$

$$h \rightarrow \infty \quad \begin{cases} m_h^+ \rightarrow C_1 \\ m_h^- \rightarrow C_2 \end{cases} \qquad and \qquad \begin{cases} C_1 = -\left|\theta_1 / \rho\right| \\ C_2 = -\left|\theta_2 / \rho\right| \end{cases}$$

In the above equation, h presents the equilibrium path that covers the short-run to long-run equilibrium, and m_h^+, m_h^- demonstrate, respectively, the positive and

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negative Error Correction Terms, ECT. if m_h^+, m_h^- have statistically significantly different from each other, it could be stated that there is an asymmetric dynamic relationship among variables (Hussain et al., 2019).

4. Empirical Results

To fulfil the essential goals of this study through the non-linear ARDL model, the monthly logarithmic data of GDP and real exchange rate, during the period of 2006:04 to 2019:03, have been employed. Before conducting operational analysis of the research, the applied variables of this study will be introduced as follows:

Table 1: Introducing the research variables

Raw	Variable	Description
1	LGDP	The Logarithm of GDP
2	dLGDP	The first difference of LGDP
3	LER	The logarithm of the real exchange rate
4	$LRER^+_t$ (or LRERp)	The positive component of LER based on the NARDL decomposition process
5	$LRER^-_t$ (or LRERn)	The negative component of LER based on the NARDL decomposition process
6	$dLRER^+_t$	The first difference of LRERp
7	$dLRER^-_t$	The first difference of LRERn

As mentioned in the methodology of the NARDL model, the input variables have to be decomposed based on equation (2). After the decomposition stage and generating the research variables, to have least errors in modelling the relationship between the main variables of the survey, it is essential to investigate some pre-modelling test, like unit root. Since most of economic variables are non-stationary, testing the stationary of them is necessary to avoid spurious regression. In line with this, the ADF stationary test, introduced by Dicky and Fuller (1979), has been applied to the study variables, as follows:

Table 2: Unit-Root Test

	At Level			At First difference	
	None	Intercept	Intercept and Trend	None	esult
LGDP	-1.321 (0.172)	-2.291 (0.178)	-2.708 (0.234)	-12.529 (0.000)	(1)
$LRER^+_t$	-1.219 (0.204)	-1.864 (0.247)	-2.265 (0.306)	-10.008 (0.000)	(1)
$LRER^-_t$	0.976 (0.992)	1.638 (0.999)	-0.017 (0.998)	-5.938 (0.000)	(1)

* At a confidene level of 95%

Source: Author's calculations

According to the results of ADF test, it is illustrated that GDP and both components of the exchange rate are first difference integrated, i.e. I(1). This issue corroborates with the error correction models' conditions owing to the fact that in such models, at least two non-stationary variables are required to have long and dynamic short-run relationships. Moreover, to have a convergence dynamic short-run relationship, there should be at least one co-integration vector among non-stationary variables. Hence, in the following, the co-integration among LGDP, LRERp and LRERn will be tested by the Johansen- Juselius method, a powerful test which is proposed in 1990.

Table 3: Co-integration Test among LGDP, LRERp and LRERn

Data Trend	**N one**	**one**	**L inear**	**Li near**	**Qu adratic**
Test Type	2		1	1	2
Trace Max-Eigenvalue	1		1	1	2

* Critical values based on MacKinnon-Haung-Michelis (1999) and lag interval: 1 to 4

Source: Author's calculations

As it can be seen in the table (3), at least one linear and two non-Linear co-integration relationship, which could be a validated sign to apply the NARDL model, are existence among the research variables.

Table 4: NARDL Estimation Results

Long-Run	**Coefficient**	**Dynamic Short-Run**	**Coefficient**
The Dependent Variable	LGDP	The Dependent Variable	GDPG (dLGDP)
C	1.93*	C	0.74***
$LRER^{+}_{t}$	-0.84*	$LGDP_{t-1}$	0.61*
$LRER^{-}_{t}$	-0.59*	$LRER^{+}_{t-1}$	-0.16*
		$LRER^{-}_{t-1}$	-0.11*
		$dLGDP_{t-1}$	0.38*
		$dLGDP_{t-2}$	0.17**
		$dLGDP_{t-3}$	0.12***
		$dLRER^{+}_{t}$	-0.31**
		$dLRER^{-}_{t}$	-0.14**
Adjusted R-squared:	0.96	Ljung-Box (1):	0.0097 (0.922)
F-statistic: (0.000)	24264.41	ARCH (1):	0.823 (0.365)

*, **, and ***, respectively, represent 1%, 5%, and 10% significance level.

Source: Author's calculations

Based on the results presented in the table (4), in the long run, all coefficients are significant at 1% level, while in the dynamic short-run relationship, the constant and $dLGDP_{t-3}$ coefficients are significant at 10%. Furthermore, estimation of

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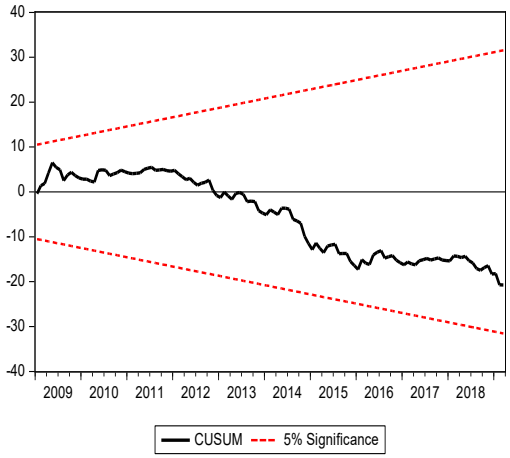
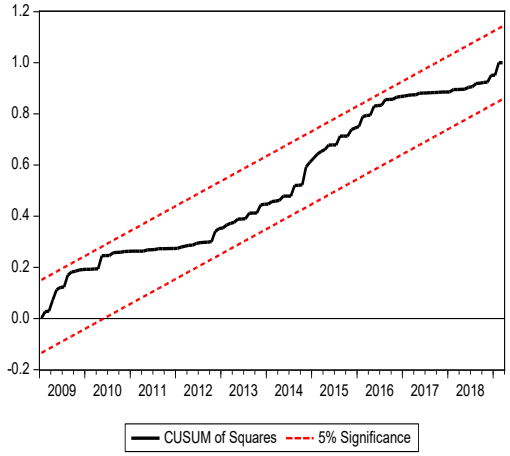
NARDL demonstrates an indirect relationship among logarithmic GDP and GDPG, as the dependent variables, and both logarithmic components of real exchange rate and its changes (DLRER). Regarding the reliability of above results, adjusted R-square and F statistic endorse the significance of the whole estimation. In line with this, the Ljung-Box and ARCH tests illustrate that neither is there serial correlation, nor is there signs of heteroscedasticity among residuals of estimated model. Moreover, through Cusum and Cusum square tests, the stability of estimated model is examined. The graphs of these tests, Cusum and Cusum square, are presented as follows:

Graph 3: Cusum test



Graph 4: Cusum Square test



Source: Author's calculations

As it can be seen in the above graphs, the results of Cusum and Cusum square tests verify the existence of stability in the estimated model. To be more precise, the model's residuals in both graphs are in the threshold bound, which means the results of model are stable and valid.

Furthermore, to statistically evaluate the authenticity of applying NARDL, the final test should be done. This test is investigating the asymmetric relationship by Wald test, as follows:

Table 5: Testing Asymmetric coefficients

H_0	Value	Chi-square	Probability	Results
		Long-Run		
$C_1 = C_2$	-0.2502	7.721439	0.021529	Rejected
		Dynamic Short-Run		
$\sum_{i=0}^{q_1} \beta_i = \sum_{k=0}^{q_2} \beta_k$	-0.1668	5.897832	0.043366	Rejected
$m_h^+ = m_h^-$*	-0.0819	6.128596	0.039304	Rejected

* $ECT^+ = \sum_{r=0}^{h} \frac{\partial LGDP_{t+r}}{\partial LRER_{t+r}^+} = (-0.16/0.61) = -0.264$; $ECT^- = \sum_{r=0}^{h} \frac{\partial LGDP_{t+r}}{\partial LRER_{t+r}^-} = (-0.11/0.61) = -0.182$)

Source: Author's calculations

Providing the Wald test, it has been approved that the long run (C_1, C_2), short-run $(\sum_{i=0}^{q_1} \beta_i, \sum_{k=0}^{q_2} \beta_k)$, and dynamic error correction terms (m_h^+, m_h^-), are asymmetric. An interesting point about the different amounts of (C_1, m_h^+) and also (C_2, m_h^-) demonstrate that h (the status of the variables' relationship on the equilibrium path) is at the first steps of moving to long-run position. On the other words, the closer amounts of either m_h^+ to C_1 or m_h^- to C_2, the fewer distance form long-run balance.

5. Conclusion

To eventually provides additional insight into the debate on the relationship between US-dollar real exchange rate movements, the main concern of this study is to determine whether the adverse effects of an increase in the exchange rate would overweigh its incremental effects on the economic growth in the case of Iran. This idea comes from the fact that most empirical works, especially in Iran, have used traditional (linear and symmetric) methods to analyze the relationships between these variables, which typically have relatively poor results, however, this article attempts to take another look at this issue with the help of applying new analytical methods. In line with this, the main contribution of this research to the literature is considering the recent fluctuations in the foreign exchange market and changes in the economic growth, applying a dynamic perspective, and using a nonlinear and asymmetric framework, NARDL, in response to changes in the economic agents' behavior in Iran as a result of severe sanctions and "Maximum Pressure" policy against Iran.

The results of empirical model which satisfied the post-modelling (diagnostic) tests demonstrate that, in the long run, although there is a negative and significant relationship between different components of the real exchange rate and GDP, the magnitude of effects of exchange rate's positive components is significantly more than that of the negative components of exchange rate, respectively -0.84 and -0.59 (more than forty percent). It means that, in the long-run and in average, an increase in the exchange rate can be led to more decrease in GDP than the effects of same amount of decline in the exchange rate on GDP. Another interesting finding of this study is that, approximately, the same results are achieved in the short run, e.g. existence of negative and asymmetric relationship between different components of exchange rate and economic growth rate and also the higher impacts of the positive components of exchange rate, compared to its negative components, on economic growth. This finding proves that although the magnitude of effects of components of exchange rate on GDP and its changes (economic growth) are remarkably different, the nature and concept of these variables relationships variables was the same in different time horizon that indicates the roots of existing nonlinear and asymmetric relationships among these variables are so strong that change in time horizon, from short run to long run, has also not been able to change them. In addition, the results of calculating different ECT coefficients, i.e. ECT^{+} and ECT^{-}, indicate that there is a dynamic relationship in the estimated models with the positive and negative components of exchange rate. On this basis, the results demonstrate if an exogenous positive or negative shock makes the model lose its long-term equilibrium path, the impact of this shock will be disappeared or neutralized, respectively, after about 4 or 5 months (these number of months are calculated through reversing the coefficients of positive and negative ECTs.).

Therefore, not only nonlinear modelling has been able to significantly model the relationships between different components of real exchange rate and economic growth, but combining this modelling technique with an asymmetric analysis approach has shown that it can lead to reliable results. To be more precise, the results of Wald test both in long-run and dynamic short-run perspectives, which is presented in table (5), along with the stability of the results based on the Cusum and Cusum square tests have significantly proved that considering the idea of separating the impacts of exchange rate's negative and positive changes on economic growth significantly works. Accordingly, proof of this claim shows that to model the relationship between exchange rate and economic growth in Iran, the use of non-linear and asymmetric models would stochastically lead to significant and reliable results.

Ultimately, the main suggestions of this paper are as follows. (i) since our results emphasize the negative and significant relationships between the various components of the exchange rate and economic growth, any financial and economic policies that can lead to greater currency appreciation should be a priority for macroeconomic policy-makers. Like implementing a set of targeted monetary and fiscal policies to enhance the value of the domestic currency, prioritizing export-oriented policies for production of domestic goods and services, establishing

targeted import tariffs to reduce the trade deficit and strengthen the trade balance, etc. (ii) due to the more destructive impacts of an increase in the exchange rate, compared to its decrease, on halting the economic growth, it recommends to monetarist authorities that they must take more proactive response whenever the foreign exchange market is facing an increasingly turbulent trend based on the managed float regime. (iii) Finally, our findings support the idea that as long as the economic sanctions and the manipulation of the foreign exchange market (by the central bank) exist in the Iran economy, behaviors of economic agents cannot follow a linear and symmetric structure. On this basis, considering the high accuracy of asymmetric and nonlinear models in examining the relationships between exchange rate and economic growth, another suggestion to the policy makers, investors, and market participants can be using asymmetric and nonlinear type frameworks to accurately and significantly model the relationship between different variables. Under such circumstance, not only will a more accurate understanding of the current situation be achieved, but also policies based on which will have more efficient and effective results. However, if this point is ignored in analyzing the relationship between different sectors of such economy, the related policies would have a significant bias.

References

Adeniran, J.O., Yusuf, S.A., Adeyemi, O.A. (2014). *The Impact of Exchange Rate Fluctuation on the Nigerian Economic Growth: An Empirical Investigation*. International Journal of Academic Research in Business and Social Sciences, 4 (8): 224-233.

Alagidede, P., Ibrahim, M. (2017). *On the Causes and Effects of Exchange Rate Volatility on Economic Growth: Evidence from Ghana*. Journal of African Business, 18(2): 169-193.

Ali, S. Z., Anwar, S. (2011). *Supply-side effects of exchange rates, exchange rate expectations and induced currency depreciation*. Economic Modelling, 28(4): 1650-1672.

Banerjee, A., Dolado, J.J., Mestre, R. (1998). *Error-Correction Mechanism Tests for Co-integration in a Single-Equation Framework*. Wadham College and Institute of Economics and Statistics, University of Oxford, Universidad Carlos III de Madrid and Research Department, Bank of Spain, 267-283.

Benhima, K. (2012). *Exchange rate volatility and productivity growth: the role of liability dollarization*. Open Economies Review, 23(3): 501–529.

Chandan Babu, N., Rohit Sagar, R., Avinash, D. (2019). *The Effect of Exchange Rate and Crude Oil on Growth Rate of Indian Economy*. International Journal of Advance and Innovative Research, 6(1): 43-47.

Cushman, D.O., De Vita, G. (2017). *Exchange rate regimes and FDI in developing countries: A propensity score matching approach*. Journal of International Money and Finance, 77: 143-163.

Farzanegan, M.R., Krieger, T. (2019). *Oil booms and inequality in Iran*. Review of Economic Development, 23(2): 830-859.

Glüzmann, P.A., Levy-Yeyati, E., Sturzenegger, F. (2012). *Exchange rate undervaluation and economic growth: Díaz Alejandro (1965) revisited*. Economics Letters, 117(3), 666–672.

Habib, M.M., Mileva, E., Stracca, L. (2017). *The real exchange rate and economic growth: Revisiting the case using external instruments*. Journal of International Money and Finance 73(B): 386-398.

Hadj Fraj, S., Hamdaoui, M., Maktouf, S. (2018). *Governance and economic growth: The role of the exchange rate regime*. International Economics, 156: 326-364.

Harms, P., Kretschmann, M. (2009). *Words, deeds and outcomes: A survey on the growth effects of exchange regimes*. Journal of Economic Surveys, 23(1): 139–164.

Hussain, I., Chen, L., Mirza, H.T., Xing, K., Chen, G. (2019). *A Comparative Study of Sonification Methods to Represent Distance and Forward-Direction in Pedestrian Navigation*. International Journal of Human–Computer Interaction, 30(9): 740-751.

Komijani, A., Naderi AbBandani, E., Gandali Alikhani, N. (2014). *A hybrid approach for forecasting of oil prices volatility*. OPEC Energy Review, 38(3): 323-340.

Mao, R., Yao, Y., Zou, J. (2019). *Productivity growth, fixed exchange rates, and export-led growth*. China Economic Review, 56: 101311.

Motahari, M.A., Lotfalipour, M.R., Ahmadai Shadmehri, M.T. (2018). *The Effects of Real Exchange Rate on Economic Growth in Iran: New Findings with Non-Linear Approach*. Applied Theories of Economics, 4(4): 175-198.

Nademi, Y., Baharvand, N. (2019). *Modeling the Effective Factors on Economic Growth in Iran: Markov Switching GARCH Approach***.** Quarterly Journal of Fiscal and Economic Policies, 6(24): 33-58.

Parsa, H., Keshavarz, H., Mohamad Taghvaeeorcid, V. (2019). *Industrial Growth and Sustainable Development in Iran*. Iranian Economic Review (IER), 23(2): 319-339.

Pesaran, M. H., Y. Shin, R. Smith (2001). *Bounds testing approaches to the analysis of level Relationships*. Journal of Applied Econometrics, 16(3): 289–326.

Petreski, M. (2010). *Exchange-Rate Regime and Economic Growth: A Review of the Theoretical and Empirical Literature*. Economics Discussion Paper No. 2009-31: 1-17.

Reed, M., Najarzadeh, R., Sadati, S.Z. (2019). *Analyzing the Relationship between Budget Deficit, Current Account Deficit, and Government Debt Sustainability*. Journal of WEI Business and Economics, 8: 20-31.

Ribeiro, R.S.M., McCombie, J.S.L., Lima, G.T. (2019). *Does Real Exchange Rate Undervaluation Really Promote Economic Growth?*. Structural Change and Economic Dynamics, 25: 408-417.

Rodrik, D. (2008). *The real exchange rate and economic growth*. Brookings Papers on Economic Activity: 412-365.

Shin, Y., Yu, B., Greenwood-nimmo, M. (2014). *Modelling asymmetric co-integration and dynamic multipliers in a nonlinear ARDL framework*. In R. C. Sickles, & W. C. Horrace (Eds.), Festschrift in Honor of Peter Schmidt Econometric Methods and Applications, 281-314.

Vita, G.D., Kyaw, K.S. (2011). *Does the choice of exchange rate regime affect the economic growth of developing countries?* The Journal of Developing Areas, 45: 135–153